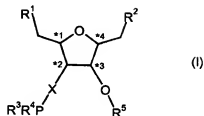


WHAT IS CLAIMED IS:

1. Compounds of the formula (I)



where

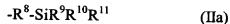
*1, *2, *3 and *4 are each independently a stereogenic carbon atom which has R- or S- configuration,

X is absent or is oxygen and

R¹ and R² may each independently be hydrogen, C₁-C₂₀-alkyl, C₁-C₂₀-fluoroalkyl, C₂-C₂₀-alkenyl, C₄-C₂₄-aryl, C₅-C₂₅-arylalkyl, C₆-C₂₆-arylalkenyl or NR⁶R⁷, OR⁷, -(C₁-C₈-alkyl)-OR⁷, -(C₁-C₈-alkyl)-NR⁶R⁷ or -O₂CR⁷,

where R⁶ and R⁷ are each independently C₁-C₈-alkyl, C₅-C₁₅-arylalkyl or C₄-C₁₄-aryl, or R⁶ and R⁷ together are a cyclic amino radical having a total of 4 to 20 carbon atoms,

or R¹ and R² are each independently radicals of the formula (IIa)



where

R^8 is absent or is oxygen or methylene and

R^9 , R^{10} and R^{11} are each independently C_1 - C_{12} -alkyl, C_5 - C_{15} -arylalkyl or C_4 - C_{14} -aryl and

5

R^3 and R^4 are each independently R^{12} , OR^{13} or $NR^{14}R^{15}$ where R^{12} , R^{13} , R^{14} and R^{15} are each independently C_1 - C_{12} -alkyl, C_5 - C_{15} -arylalkyl or C_4 - C_{14} -aryl, or $NR^{14}R^{15}$ together is a cyclic amino radical having 4 to 20 carbon atoms, or R^3 and R^4 together are $-O-R^{16}-O-$ where R^{16} is a radical selected from the group of C_2 - C_4 -alkylene, 1,2-phenylene, 1,3-phenylene, 1,2-cyclohexylene, 1,1'-ferrocenylene, 1,2-ferrocenylene, 2,2'-(1,1'-binaphthylene), 2,2'-(1,1'-biphenylene and 1,1'-(diphenyl-2,2'-methylene)diyl, and the radicals mentioned may optionally be mono- or polysubstituted by radicals selected from the group of fluorine, chlorine, C_1 - C_8 -alkoxy and C_1 - C_8 -alkyl and

10

15

R^5 is hydrogen, C_1 - C_{20} -alkyl, C_4 - C_{24} -aryl, C_5 - C_{25} -arylalkyl, C_1 - C_{20} -haloalkyl or a radical of the formula (IIb)

20

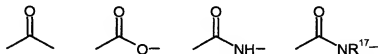


where

A is absent or is C_1 - C_{12} -alkylene

25

B is a functionality which is selected from the group of



where

R¹⁷ may be C₁-C₂₀-alkyl, C₄-C₂₄-aryl, C₅-C₂₅-arylalkyl

and

5 D is C₁-C₈-alkyl, C₄-C₂₄-aryl or C₅-C₂₅-arylalkyl or

B and D, in the case that A is not absent, are together optionally cyano or
[(C₁-C₈-alkylene)-O]_n-(C₁-C₈-alkyl) where n is an integer between
1 and 8 or

10

R¹⁷ and D together are a cyclic amino radical having 4 to 12 carbon atoms.

2. Compounds according to Claim 1, characterized in that *1, *2, *3 and *4
together define the following stereoisomers of the central substituted furan
15 ring:

(1R,2R,3R,4R), (1R,2R,3R,4S), (1R,2S,3S,4S), (1R,2S,3S,4R),
(1R,2R,3S,4R), (1S,2S,3R,4S), (1S,2S,3S,4S), (1S,2S,3S,4R),
(1S,2R,3R,4R), (1S,2R,3R,4S), (1S,2S,3R,4S), (1R,2R,3S,4R).

20

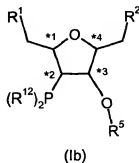
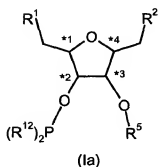
3. Compounds according to Claim 1, characterized in that R¹ and R² are each
independently hydrogen, tert-butoxy, trityloxy, tert-butyl dimethylsilyloxy,
tert-butyl diphenylsilyloxy, trimethylsilyloxy, triethylsilyloxy,
triisopropylsilyloxy, neopentoxy or 1-adamantoxy.

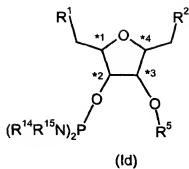
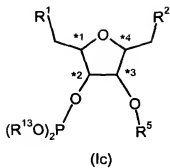
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4. Compounds according to Claim 1, characterized in that R¹ and R² are
identical.

5. Compounds according to Claim 1, characterized in that R³ and R⁴ are each
30 independently R¹², OR¹³ or NR¹⁴R¹⁵ where R¹², R¹³, R¹⁴ and R¹⁵ are each

- independently C₁-C₁₂-alkyl or C₄-C₁₄-aryl, or NR¹⁴R¹⁵ together is a cyclic amino radical having 4 to 12 carbon atoms, or R³ and R⁴ together are -O-R¹⁶-O- where R¹⁶ is ethylene, 1,2-phenylene, 1,3-phenylene, 1,2-cyclohexylene, 1,1'-ferrocenylene, di- or tetra-C₁-C₈-alkyl-substituted 1,1'-(diphenyl-2,2'-methylene)diyl, 1,2-ferrocenylene, 2,2'-(1,1'-binaphthylene) or 2,2'-(1,1'-biphenylene, and 2,2'-(1,1'-binaphthylene) or 2,2'-(1,1'-biphenylene is substituted at least in the 6,6'-position by radicals which are selected from the group of C₁-C₈-alkoxy and C₁-C₈-alkyl, and is optionally substituted in the 5,5'-, 4,4'-, 3,3'- or 2,2'-position by radicals which are selected from the group of fluorine, chlorine, C₁-C₈-alkoxy and C₁-C₈-alkyl.
6. Compounds according to Claim 1, characterized in that R⁵ is hydrogen, C₁-C₄-alkyl, -CO(C₁-C₄-alkyl), benzyl-CO-phenyl or phenyl, and benzyl or phenyl is optionally further substituted by one, two or three substituents selected from the group of C₁-C₄-alkyl, C₁-C₄-alkoxy or C₁-C₄-haloalkyl.
7. Compounds according to Claim 1, characterized in that they are of the formulae (Ia) to (Id)





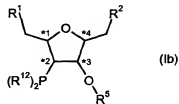
where *1,*2,*3,*4, R¹, R², R⁵, R¹², R¹³, R¹⁴ and R¹⁵ are as defined under formula (I).

5

8. 2-*O*-(Di(2,4-dimethylphenyl)phosphino)-1,6-di-*O*-(*tert*-butyldiphenylsilyl)-2,5-anhydro-D-mannitol.

9. Process for preparing compounds of the formula (Ib)

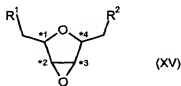
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where

15

R¹, R², R⁵, R⁶ and R¹² are as defined under formula (I), comprising converting compounds of the formula (XV)



where

R^1 and R^2 are as defined under formula (I),

in the presence of compounds of the formula (XVI),

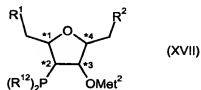


where

Me^2 is lithium, sodium or potassium and

10 R^{12} has the definition specified under (I),

to compounds of the formula (XVII)



15 where

R^1 , R^2 , Me^2 and R^{12} are as defined above, and

20 reacting the compounds of the formula (XVII) with compounds of the formula (XIII),



where

25 R^5 has the same definitions as specified under formula (I) and

Z is chlorine, bromine, iodine or $R^{19}SO_3$ where R^{19} is C_1 - C_{12} -alkyl, C_1 - C_{12} -haloalkyl, C_5 - C_{25} -arylalkyl or C_4 - C_{24} -aryl, and, in the case that R^5 is to be bonded via a carbonyl group, is optionally R^5O -.

- 5 10. Transition metal complexes containing compounds according to Claim 1 and a transition metal compound.
11. Transition metal complexes according to Claim 10, characterized in that the transition metal is selected from the group of ruthenium, osmium, cobalt, rhodium, iridium, nickel, palladium, platinum and copper.
12. Transition metal complexes according to Claim 10, characterized in that the molar ratio of transition metal to the compounds is 1:2, 1:3 or 1:4.
- 15 13. Transition metal complexes according to Claim 10, which is of the formula (XIX)



where

20

(I) is a compound of the formula (I) as defined in claim 1 and

M is rhodium or iridium.

- 25 14. Transition metal complexes according to Claim 10 characterized in that they are obtained by reacting the transition metal compounds and the compounds .
15. Transition metal complexes according to Claim 14, characterized in that the transition metal compounds used are:
- 30

transition metal compounds of the formula (XXa)



where

5

M is rhodium, iridium, ruthenium, nickel, palladium, platinum or copper and

10

An¹ is chloride, bromide, acetate, nitrate, methanesulphonate, trifluoromethanesulphonate or acetylacetonate and

q is 3 for rhodium, iridium and ruthenium, is 2 for nickel, palladium and platinum, and is 1 for copper,

15

or transition metal compounds of the formula (XXb)



where

20

M is ruthenium, iridium, ruthenium, nickel, palladium, platinum or copper and

25

An² is chloride, bromide, acetate, methanesulphonate or trifluoromethanesulphonate, tetrafluoroborate or hexafluorophosphate, perchlorate, hexafluoroantimonate, tetra(bis-3,5-trifluoromethylphenyl)borate or tetraphenylborate and

q is 1 for rhodium and iridium, is 2 for ruthenium, nickel, palladium and platinum, and is 1 for copper,

30

L^1 is in each case C_2 - C_{12} -alkene, , or a nitrile, or

L^1_2 together is a $(C_4$ - $C_{12})$ -diene,,

5 or transition metal compounds of the formula (XXc)



where

10 M is ruthenium and

L^2 is an aryl radical, or methylallyl,

or transition metal compounds of the formula (XXd)

15



where

M is palladium, nickel, iridium or rhodium and

20

An^3 is chloride or bromide and

Met^3 is lithium, sodium, potassium, ammonium or an organic ammonium ion and

25

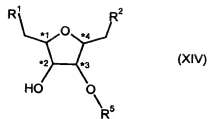
q is 3 for rhodium and iridium, and is 2 for nickel, palladium and platinum,

or transition metal compounds of the formula (XXe)

30

asymmetric hydroformylations, asymmetric hydrocyanations, asymmetric Heck reactions and asymmetric hydrogenations.

20. The process of Claim 18, characterized in that the stereoisomerically enriched compounds are used for preparing active ingredients in pharmaceuticals and agrochemicals, or intermediates of both of these classes.
21. Process for preparing stereoisomerically enriched compounds by catalytic hydrogenations of olefins, enamines, enamides, imines or ketones, 1,4-additions, hydroformylations, hydrocyanations or Heck reactions, comprising providing catalysts which contain transition metal complexes according to Claim 10.
22. Process according to Claim 21, characterized in that the amount of the transition metal complexes used is 0.001 to 5 mol%, based on substrate used.
23. Process according to Claim 21, characterized in that the stereoisomerically enriched compounds are obtained by catalytic hydrogenation of olefins, enamides or imines.
24. Process according to Claim 21, characterized in that the working temperature is -20°C to 200°C .
25. Process according to Claim 21, characterized in that the hydrogen pressure is 0.1 to 200 bar.
26. Compounds of the formula (XIV)

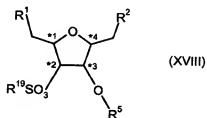


where

R^1 , R^2 and R^5 are each as defined under formula (I) in Claim 1.

5

27. Compounds of the formula (XVIII)



where

10

R^1 , R^2 and R^5 are each as defined under formula (I) in Claim 1 and

R^{19} is C_1 - C_{12} -alkyl, C_1 - C_{12} -fluoroalkyl, C_5 - C_{25} -arylalkyl or C_4 - C_{24} -aryl.